



IES

# Newsletter

Volume 18, Number 5  
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## Director's Note

Earthworms have enjoyed "good press", as friends of the garden, as tasty lures for fish, and, more recently, as workhorses in the compost bin. But research by IES scientists during the early 1990s found a positive correlation between large numbers of earthworms and poor quality forest soils.

Institute scientists have pursued that discovery and are doing comparative studies of forests with different land-use histories to predict if and how earthworms will have a significant long-term impact on forest ecosystems. That project is led by Dr. Peter Groffman, who was fortunate to be assisted in the formative days of the study by Dr. Patrick Bohlen. Dr. Bohlen was a post-doctoral associate at the Institute during 1994-98, during which time he co-authored (with C.A. Edwards at Ohio State University) *Biology and Ecology of Earthworms*, a definitive textbook on the subject. Dr. Bohlen continues to be a collaborator on this long-term investigation.

The IES Newsletter is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York.

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## Are Earthworms Undermining Our Forests?

Like a huge plow, advancing glaciers scraped the top centimeters of soil from the surface of the land that is now Canada and the northern United States. When this happened, most recently some 15,000 years ago, it wiped out the native earthworm population from these parts of North America. So, what are those creatures burrowing in your garden? They are descendants of the species that traveled here with early European and Asian settlers – maybe in potted plants from their homelands, for example – which, once freed, inexorably began to fill the earthworm void.

Earthworms are most closely related to leeches and to polychaete worms, which are mostly marine. What these animals have in common are their ring-like body segments, and for this reason they're classified in the phylum Annelida, a word derived from the Latin *annellus* which means "little ring". The reason earthworms burrow is to eat. Their muscular pharynx acts like a pump, drawing soil particles – together with whatever organic matter is associated with it – into their mouth. This food is ground up in the gizzard, then passes through the intestine where digestive enzymes break it down. By the time the worm excretes its "casting", nutrients have been absorbed into the animal's blood. Each day an earthworm can eat over a quarter of its weight in soil.

Worms fascinated Charles Darwin, and by means of his book, *The Formation of Vegetable Mould through the Action of Worms, with Observations of their Habits* (1881), this famous naturalist may have been among the first worm "PR-men". Observing casts at one site, he calculated that over the course of a year the animals brought 18 tons of soil to the surface, per acre. Based on this kind of evidence, he supported the theory that worms made ground healthier for plants by aerating, draining and mixing soil. Well over a century later, many gardeners still trust in the goodness of earthworms.

But IES scientist Dr. Peter Groffman suggests this may not necessarily be true – at least with respect to forest soils. Here's the background.

As a graduate student over a decade ago, Dr. Richard Pouyat worked with Drs. Mark McDonnell and Steward Pickett on the Institute's Urban-to-Rural Gradient Ecology project, comparing ecosystems along a

gradient from urban to rural habitats. One of the urban sites Pouyat studied was The New York Botanical Garden Forest, where he found many, many more earthworms than he found in rural soils. He noted several differences in the urban soils that were possibly related to the presence of worms, such as the lack of a forest floor (the surface organic layer of soil) and high rates of a nitrogen cycle process, nitrification, that can lead to depletion of soil fertility and pollution of groundwater. As is so often the case in science, an unexpected discovery had pointed to an entirely new research direction.

The organic layer of soil is only the top 5-10 centimeters (2-4 inches); underneath is mineral soil. In those forest patches where



PATRICK BOHLEN

*Lumbricus terrestris*, the night crawler, came to the New World with European settlers. These worms, popular as fish-bait, can grow as long as 25 centimeters (10 inches).

there are worms, scientists have found, the organic layer is quickly depleted, literally eaten up. What remains is just the mineral soil, albeit enriched mineral soil thanks to the byproducts of the worms' work. Since earthworms are extending their range (calling it an "earthworm invasion" is no exaggeration, as the animals spread out from their urban centers of introduction) and since the forest floor is gone within three to five years after worms move in, there are questions of ecosystem quality that must be addressed as we look to the future of our forests.

"Losing the forest floor raises concerns about the earthworm invasion because this organic soil layer is important. It protects the soil from erosion and helps the forest regrow following disturbance," Groffman says. "But, on the other hand, enriching the mineral soil improves the quality of this underlying soil

*continued on page 3*

# The Eco-Adventure of a Young Lifetime: A Week at IES Day Camp

by Mary Ford,  
Program Leader of Programs for Children and Teachers

"Welcome, Eco-Time Travelers!" This was the message on the banner that hung over the IES Carriage House<sup>1</sup> door throughout the summer. When children arrived for the Institute's 2001 Summer Ecology Day Camp, they embarked on a journey through time. Through explorations and experiments, campers studied the way ecosystems and landscapes change over long periods. They traveled thousands of years into the past and hundreds of years into the future.

From their home base in the Carriage House, the young time travelers investigated many different parts of the IES property. At Cary Pond, hidden on one of the Cannoo Hills, they loved getting dirty measuring the depth of the muck at the bottom of the pond in order to estimate the rate of sedimentation. At the same time, they learned about the pond's history: it was probably built in the 1920s or 1930s to provide a source of water for livestock. They hiked to a beaver pond behind the IES greenhouse, and looked for clues to solve the mysteries of when the beavers arrived and when they left. At both ponds campers used nets and buckets – not to mention insatiable curiosity – to examine the plants and animals that live in these ecosystems. And on the IES EdVenture Trail, which winds through the forest behind the Carriage House, campers learned to recognize signs of change in an ecosystem. They found evidence of blizzards, hurricanes, clearing for agriculture, invasive species, and many other disturbances. Back at the Carriage House, they did copper etchings to illustrate signs of change near their own homes.

As apprentice ecologists, of course the campers did experiments. They built "seed traps", put them up in field and forest ecosystems, and checked them regularly. This study allowed them to determine where different types of seeds were most likely to end up. Along the way, they also discovered that many seeds are very small and difficult to see without a magnifying glass! And they did an experiment on the effects of acid rain, placing one philodendron leaf in a cup with tap water (the control) and another leaf in a

cup with acidic water (the treatment). The leaves in acidic water turned brown over the course of a week, while those in tap water stayed green and healthy.

On the last day, the campers hiked to the Tea House<sup>2</sup>. The long steep walk up Cannoo Hill is like a geology field laboratory, so they got a sense of local rock formations and geologic history. Once at the Tea House they measured the diameter of trees and compared

Armstrong, a middle school science teacher from Arizona; Chris Tall and Shannon Wood, IES Ecology Education Fellows and AmeriCorps Members; and me. In addition, one Junior Counselor – each a former camper – assisted each week. It was a fabulous experience, and the Institute's educators already are planning next year's activities. The camp theme changes each year, so the 2002 camp will be full of new adventures and discoveries. Do you know any



Apprentice ecologists at the IES Ecology Day Camp search for snails and other aquatic invertebrates, tadpoles, frogs, fish, and aquatic plants in the pond microcosms behind the Carriage House. Here, from the left, are Natalie Pace, Rebecca Lyczkowski, Mary Ford and Nathan Pace.

LONNA KELLY

their numbers to measurements on a map from the 1940s. They also played games, showing off their newly gained knowledge of succession, seed dispersal, land use and experimental design in "Ecology Jeopardy". (For example – Answer: *The stage of succession that usually occurs after a major disturbance in this area.* Question: *What is a meadow?*) Later, parents and guests came to watch the children make presentations on what they had learned in camp. Each camper received a Junior Ecologist Certificate, then camp ended with everyone singing the IES Ecology Day Camp song.

The 2001 IES Ecology Day Camp consisted of eight one-week sessions, for grades 1-2 and 4-6. Ninety-six time travelers became Junior Ecologists. Camp staff included: Josh

young ecologists? We hope they'll join us next summer!

**Editor's note:** Summer camp registration begins in late winter. Look for information in the IES Newsletter or at [www.ecostudies.org](http://www.ecostudies.org).

1. The Carriage House, located behind the Gifford Garden, is so-named because of its use back when the Gifford House was a private home. The building was renovated some 10 years ago, and now contains a classroom/laboratory for students in the IES Ecology Day Camp and Ecology Field Programs as well as a separate classroom for Continuing Education Program students.

2. The Tea House, at the top of one of the Cannoo Hills, was built in the 1930s by Mary Flagler Cary and her husband Melbert Cary as their weekend retreat.

# Recognizing 25 Years of Service

Six IES employees, who were hired originally to work at the Mary Flagler Cary Arboretum and who stayed on when the Institute opened in 1983, have been at their jobs for 25 years or more. At the annual "all-employee meeting" in September, Dr. Gene E. Likens recognized these individuals for their excellent service. "As a token of appreciation," Dr. Likens said, "I present [each of] you with a Swiss Army watch, representative of the highest in quality and reliability, reflecting your efforts toward making the IES a most successful enterprise."

From the left:

**Gene Likens**, director

**Steve Bialousz**, head mechanic  
(July 1975: supervising mechanic)

**Allan Kling**, grounds foreman  
(July 1976: pruner's assistant)

**Raymond Winchcombe**, manager of the field research facility  
(July 1976: wildlife research assistant)

**John Olson**, senior groundskeeper  
(September 1972: laborer)

**David Bulkeley**, manager of the greenhouse complex  
(February 1976: greenhouse gardener)

**Bradley Roeller**, manager of the grounds and display gardens  
(July 1973: plant records and information officer)



JILL COWALLADER

## Earthworms, from page 1

layer." To determine the long-term, net effects of the earthworm invasion in forests, Groffman is collaborating with other scientists<sup>1</sup> on a new study.

Their field sites are at Tompkins Farm, a parcel of land on the line between Pleasant Valley and Clinton Hollow, N.Y., not far from Millbrook, that was donated to the Institute in the early 1990s, and at Arnot Forest, near Ithaca, N.Y. The Tompkins Farm property had been used historically for agriculture. Because of this history, there was not much forest floor to be lost to the munchings of invading earthworms, nor were the worms able to enrich the mineral soil at this site. Arnot Forest, on the other hand, had never been cultivated and had a thick forest floor. Earthworms have moved in during the past 10 years, with a resulting dramatic loss of forest floor as well as corresponding enrichment of mineral soil.

Earthworm invasions aren't uniformly spread out but rather characterized by a kind of patchiness: there will be a number of worms in one area and few or none in another. Groffman and his colleagues have

selected three forest stands each at the Tompkins Farm and Arnot Forest sites, and on each stand have established three research plots: one already invaded by earthworms (primarily *Lumbricus rubellus*, the 'red wriggler' or 'red marsh worm', which lives near the soil surface, or *Lumbricus terrestris*, the deep-burrowing 'night crawler'); one non-invaded; and one "introduction plot" – an area not previously colonized to which the scientists have added earthworms from adjacent areas.

What do the dramatic physical changes resulting from earthworm invasion mean to nutrient retention in soil and uptake by plants, and to plants' fine-root production and the chemical composition of leaves? To learn answers to these questions, the collaborators are measuring a number of parameters, including carbon, nitrogen and phosphorus content of soils and leaves; soil respiration; soil solution chemistry; microbial biomass; fine root biomass; litterfall; mycorrhizal (fungal) colonization; and biogeochemical processes such as nitrification. By analyzing data from the introduction plots, they will discover the changes that occur immediately following earthworm invasion, and by comparing data from the previously-invaded plots with those from non-invaded plots, they'll learn the longer-term consequences of invasion.

Preliminary findings indicate that, indeed, earthworms in forest soils have considerable impact on the forest ecosystem. Data suggest that these animals preferentially utilize high quality organic materials in the forest floor, leaving behind low quality residues that support low rates of nitrogen cycling. Phosphorus, too, is being lost from soils where earthworms are present. Night crawlers' deep burrows may move water quickly through soil with resultant nutrient losses. Earthworms appear to reduce the amount of fine roots, and their function. The forest floor food webs – bacteria and fungi, plant detritus, invertebrate animals – are drastically altered.

In the field of ecology, it is helpful when data are collected over the long term. This, in fact, is one of the hallmarks of the ecosystem research done at the Institute. Dr. Groffman and colleagues will continue to monitor the earthworm research plots at Tompkins Farm and Arnot Forest for enough time to develop a more complete picture of the effects of the earthworm invasion in the Northeast, and to see if this phenomenon ranks with climate change, air pollution, invasive plants and forest fragmentation as an environmental change that will have a major impact on our forests over the next 100 years.

1. Dr. Patrick Bohlen (Archbold Biological Station, Florida) and Drs. Timothy Fahey and Melany Fisk (Cornell University); postdoctoral associates Dr. Holly Ewing (IES) and Dr. Xuyong Li (Cornell University); and Cornell University graduate students Derek Pelletier and Esteban Suarez.

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### CONTINUING EDUCATION

For information, or to request a catalog, call the Continuing Education office at 845-677-9643 or visit [www.ecostudies.org/education/continuing.html](http://www.ecostudies.org/education/continuing.html).

January 2002 programs include:

#### Gardening

Jan. 8: **Color in the Winter Garden**

Jan. 19 (4 sessions, every other Sat. through Mar. 2):

#### Plant Propagation

##### Landscape Design

Jan. 5 (7 sessions): **Principles of Landscape Design**

Jan. 7 (8): **Landscape Design II**

Jan. 16 (7): **Graphics**

##### Natural Science Illustration

Jan. 13 (also the 2nd Sun. each in Feb., Mar. & Apr.):  
**Watercolors in the Greenhouse**

### SATURDAY ECOLOGY PROGRAMS

Come to **free public programs** on the first Saturday of the month. Pre-registration isn't necessary. If you have questions, call 845-677-7600 ext. 321 for information on upcoming programs:

Dec. 1: **An Origami "Winter Ecosystem"**

10 a.m. - noon at the Carriage House

*There is no Saturday Ecology Program in January.*

### IES SEMINARS

Free **scientific seminars** are held at 11 a.m. on Fridays in the Auditorium. Free.

Nov. 16: **Disturbance, Spatial Heterogeneity, and Ecosystem Function: Postfire Patterns in Yellowstone National Park.** Dr. Monica Turner, University of Wisconsin

Nov. 30: **Viewing Ecosystem Biogeochemistry as an Optimized Metabolic Network.** Dr. Joseph Vallino, Marine Biological Laboratory, Mass.

Dec. 7: **What Goes Up Must Come Down – But Where?: Atmospheric Deposition in Complex Terrain.** Dr. Kathleen Weathers, Institute of Ecosystem Studies

### GREENHOUSE

The greenhouse is a year-round tropical plant paradise and a site for controlled environmental research. Open daily until 3:30 p.m. with a free permit (see HOURS).

## Calendar

### HOLIDAY SALE WEEKEND

at

### THE ECOLOGY SHOP

*10% off all regularly priced merchandise*

- gardening and nature-inspired gifts and books
- toys • stocking stuffers • holiday plants

Friday, Nov. 30: 10 a.m. - 4 p.m.

Saturday, Dec. 1: 10 a.m. - 4 p.m.

Sunday, Dec. 2: 11 a.m. - 4 p.m.

### THE ECOLOGY SHOP

**New in the Shop** ... kitchen compost pails ...  
Audubon handmade wooden bird calls ... posy pins  
... **for children** ... pick-up snakes game ... origami  
kits ... sunprint kits ... Folkmanis® puppets for babies  
... stretch frogs, snakes, lizards ... **in the Garden**  
**Room** ... slug pubs ... paving weeder tool ...  
houseplant tool sets ... hyacinth bulb forcing kits  
**Senior Citizens Days:** 10% off on Wednesdays

### CHILDREN'S PROGRAMS

**IES Ecology Field Programs** for school groups continue throughout the winter months. Teachers may call the Education Office, at 845-677-7600 ext. 316, for information on "Plant Power" (fall, winter and spring, in the greenhouse) or "Ecology of Maple Sugaring" (Feb. 25-Mar. 22, outdoor program). The Institute's **Spring Ecology Day Camp** is held during spring break, from March 25-28. Call 845-677-7600 ext. 316 for details.

### HOURS

**Winter Hours: October 1 - March 30**

*Internal roadways and trails closed during deer hunting season, and when snow covered.*

**Free permits** are required; available at the Gifford House Visitor and Education Center until 3 p.m.

**Public attractions:** Mon. - Sat., 9 a.m.-4 p.m. and Sun. 1-4 p.m.; closed public holidays. The greenhouse closes at 3:30 p.m. daily.

**The Ecology Shop:** Mon.- Fri., 11 a.m.-4 p.m., Sat. 9 a.m.-4 p.m., and Sun. 1-4 p.m. (*Please note: The shop is closed weekdays and Saturdays from 1-1:30 p.m.*)

### MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the newsletter, member's rate for courses and excursions, a 10% discount on IES Ecology Shop purchases, and participation in a reciprocal admissions program. Individual membership: \$40; family membership: \$50. Call the Development Office at 845-677-7600 ext. 120.

### The Institute's Aldo Leopold Society

In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call the Development Office at 845-677-7600 ext. 120.

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Street address: Plant Science Building,  
65 Sharon Tpke. (Rte. 44A), Millbrook, N.Y.

**... for education, general information and The Ecology Shop:**

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The Ecology Shop: 845-677-7600 ext. 309  
Street address: Gifford House Visitor and Education Center, 181 Sharon Tpke. (Rte. 44A), Millbrook, N.Y.  
**... IES website:** [www.ecostudies.org](http://www.ecostudies.org)

For information on current IES public events and attractions, visit: [www.ecostudies.org/welcome/ThisWeek.html](http://www.ecostudies.org/welcome/ThisWeek.html).

For garden tips, follow the link to the Perennial Garden Archives.